

**CLAIMS:**

1. An apparatus for engaging a rotary driving member with an element to be driven, the apparatus  
5 including a housing containing:

a first rotatable member capable of being axially moved into positive engagement with a second rotatable member, one of the first or the second rotatable members being drivably connected to the rotary driving member and  
10 the other of the first or the second rotatable members being drivably connected to the element to be driven such that positive engagement between the first and second rotatable members effects engagement of the rotary driving member with the element to be driven;

15 a piston slidably mounted in the housing, the piston being operably connected with the first rotatable member such that pressure acting on one end of the piston effects axial movement of the piston with respect to the housing, thereby effecting axial movement of the first  
20 rotatable member; and

a delay device for delaying the establishment of a positive connection between the first and second rotatable members, the delay device having:

means for producing a friction drive between the  
25 first and second rotatable members to cause rotation of the rotatable member that is drivably connected to the element to be driven prior to engagement of the first and second rotatable members; and

a friction drive actuator, the actuator being  
30 axially movable to activate the friction drive;

wherein the piston has a passageway through it such that pressure acting on the end of the piston also acts on the friction drive actuator to effect movement of it.

2. An apparatus according to claim 1, wherein the axially movable first rotatable member is drivably connected to the rotary driving member and the second  
5 rotatable member is drivably connected to the element to be driven.

3. An apparatus according to claim 1, wherein the second rotatable member is drivably connected to the  
10 rotary driving member and the axially movable first rotatable member is drivably connected to the element to be driven.

4. An apparatus according to any one of claims 1  
15 to 3 having restraining means to restrict initial axial movement of the piston, such that pressure acting on the piston produces movement of the friction drive actuator prior to movement of the piston.

20 5. An apparatus according to claim 4, wherein the restraining means is a spring.

6. An apparatus according to any one of the preceding claims, wherein  
25 the first rotatable member moves in a first direction into positive engagement with the second rotatable member;

the friction drive actuator moves in a second direction to activate the friction drive; and  
30 the first direction is substantially opposite the second direction.

7. An apparatus according to claim 6, wherein

the piston includes a first end portion and a second end portion, each end portion being slidably received in a respective first and second cylinders formed in opposite ends of the housing;

5       the passageway opens into one of the cylinders via a radial hole in the piston, such that pressure from the passageway acts on the side of that cylinder; and

fluid communication means are provided between the friction drive actuator and the side of the cylinder so  
10       that pressure acting on said side of the cylinder also acts the friction drive actuator.

8.     An apparatus according to claim 7 arranged so that pressure acting on the first end portion axially  
15       moves the piston so as to effect engagement of the first rotatable member with the second rotatable member, and pressure acting on the second end portion axially moves the piston so as to effect disengagement of the same.

20       9.     An apparatus according to either one of claims 7 or 8, wherein the passageway extends through the piston between the first cylinder and the second cylinder.

10.    An apparatus according to any one of claims 7  
25       to 9, wherein the fluid communication means includes a bore through the housing.

11.    An apparatus according to any one of claims 7  
to 10, wherein sealing means are located around the  
30       piston at a predetermined axial distance from each side of the radial hole, the sealing means defining a zone in which pressure from the passageway acts.

12. An apparatus according to claim 11, wherein the sealing means are sealing rings positioned around the piston.

5        13. An apparatus according to either one of claim 11 or 12, wherein the sealing means are positioned such that the zone is isolated from the fluid communication means when the piston has moved the first rotatable member a predetermined distance towards engagement with  
10 the driven member.

14. An apparatus according to any one of the preceding claims, wherein the piston includes a valve arrangement whereby the pressure ceases to act on the  
15 friction drive actuator just before or at the same time as positive engagement is established between the first and second rotatable members.

15. An apparatus according to any one of the preceding claims, wherein the friction drive actuator is  
20 biased away from activating the friction drive.

16. An apparatus according to claim 15, wherein the friction drive actuator is biased by a spring.  
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17. An apparatus according to any one of the preceding claims, wherein the friction drive actuator includes an annular pressure ring slidably mounted in the housing.  
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18. An apparatus according to claim 17, wherein the area of the annular pressure ring on which the pressure

acts is greater than the area of the piston on which pressure acts.

19. An apparatus according to any one of the  
5 preceding claims, wherein the means for producing a friction drive include a plurality of axially movable friction plates, a first set of which are rotatably engaged with the first rotatable member and a second set of which are rotatably engaged with the second rotatable  
10 member, the plurality of friction plates being arranged so that they first and second set are pushed together by the friction drive actuator.

20. An apparatus according to claim 19, wherein  
15 each friction plate of the first set is provided between friction plates of the second set.

21. An apparatus according to any one of the preceding claims, wherein the second rotatable member  
20 includes a gear mounted on a shaft, the gear being engageable with the first rotatable member to effect engagement between the first and second rotatable members.

22. An apparatus according to claim 21, wherein the  
25 gear mounted on the shaft is axially movable, and the friction drive actuator is arranged to act on the gear to push it to activate the friction drive.

23. An apparatus according to either one of claims  
30 21 or 22, wherein the first rotatable member includes a sleeve coaxial with the shaft, the sleeve being engagable with the gear.

24. An apparatus according to claim 23, wherein the piston includes a fork member with fingers that engage a groove in the outer surface of the sleeve.

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25. An apparatus according to any one of the preceding claims, wherein the pressure is provided by compressed gas.

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26. An apparatus according to any one of the preceding claims, wherein the pressure is provided by compressed air.